

In the Claims.

1. – 76. (Cancelled.)

77. (Currently amended.) A process for the production of purified biodiesel from a feedstock containing at least one fatty acid, the process comprising:

(A) converting the at least one fatty acid in the feedstock to a glyceride;

(B) reacting the glyceride with at least one alcohol to produce a fatty acid alkyl ester and glycerin wherein the reaction is conducted in a transesterification reactor and further wherein the at least one alcohol is added to the transesterification reactor at a rate that is greater than the stoichiometric amount of alcohol required for transesterification; and

(C) separating the product of step (B) into a fatty acid alkyl ester rich stream and a glycerin rich stream; and

_____ (D) purifying the fatty acid alkyl ester rich stream by distillation or fractionation to produce purified biodiesel having an acid number less than or equal to 0.80 mg KOH/g and total glycerin less than or equal to 0.240% mass.

78. (Previously presented.) The process of Claim 77, wherein step (A) comprises mixing the feedstock with glycerin for a time sufficient to convert the at least one fatty acid in the feedstock to a glyceride.

79. (Previously presented.) The process of Claim 78, wherein the feedstock and glycerin is mixed at an elevated temperature in the absence of a catalyst.

80. (Previously presented.) The process of Claim 77, wherein step (B) comprises reacting the glyceride with the at least one alcohol in the presence of an alkali catalyst to produce glycerin and the fatty acid alkyl ester.

81. (Previously presented.) The process of Claim 78, wherein the glycerin is purified.

82. (Cancelled.)

83. (Previously presented.) The process of Claim 78, wherein the at least one fatty acid in the feedstock is converted to a glyceride by adding glycerin to the feedstock while mixing and subjecting the admixture to reduced pressure.

84. (Previously presented.) The process of Claim 77, wherein prior to step (A) the feedstock is conditioned to remove solids.

85. (Previously presented.) The process of Claim 78, wherein the at least one fatty acid in the feedstock is converted to a glyceride in a glycerolysis reactor and further wherein glycerin is continuously added at a rate greater than the stoichiometric amount of glycerin required for glycerolysis.

86. (Previously presented.) The process of Claim 77, wherein the feedstock comprises at least one fatty acid at a concentration in the range of about 3 to about 97 percent by weight.

87. (Previously presented.) The process of Claim 85, wherein in step (A) glycerin is continuously added to the glycerolysis reactor at a rate in the range of about 110 percent to about 400 percent of the stoichiometric amount of glycerin required for glycerolysis.

88. (Previously presented.) The process of Claim 77, wherein in step (B) the alcohol is added at a rate equal to about 200 percent of the stoichiometric amount of alcohol required for transesterification.

89. (Previously presented.) The process of Claim 77, wherein the process is continuous.

90. (Cancelled.)

91. (Cancelled.)

92. (Currently amended.) The process of Claim ~~90~~ 197, wherein the free fatty acids in the feedstock are reacted with glycerin in the absence of a catalyst.

93. (Cancelled.)

94. (Currently amended.) The process of Claim ~~90~~ 159, wherein the glycerides are reacted with the at least one alcohol in the presence of an alkali catalyst.

95. (Cancelled.)

96. (Currently amended.) The process of Claim ~~90~~ 169, further comprising purifying the fatty acid alkyl ester rich stream in a distillation or fractionation ~~system~~ column.

97. (Currently amended.) The process of Claim ~~90~~ 159, further comprising adjusting the pH of the glycerin rich stream to neutral and then purifying the neutralized stream by distillation or fractionation.

98. (Cancelled.)

99. (Currently amended.) The process of Claim ~~90~~ 198, wherein the at least

two reactors have a combined residence time of not more than about 500 minutes.

100. (Currently amended.) The process of Claim ~~90~~ 159, wherein the at least one alcohol is a C₁-C₅ alcohol.

101. (Cancelled.)

102. (Cancelled.)

103. (Cancelled.)

104. (Previously presented.) The process of Claim 170, wherein the conditioned feedstock is a substantially uniform mixture of liquid lipids having a temperature in the range of about 35°C to about 250°C.

105. (Cancelled.)

106. (Previously presented.) The process of Claim 94, wherein the alkali catalyst is selected from the group consisting of sodium hydroxide and potassium hydroxide.

107. (Currently amended.) The process of Claim ~~90~~ 159, wherein step ~~(B)~~ (A) is conducted at a temperature in the range from about 20°C to about 250°C.

108. (Cancelled.)

109. (Currently amended.) The process of Claim ~~90~~ 159, wherein step ~~(B)~~ (A) is conducted at an absolute pressure in the range of about 1 bar to about 250 bar.

110. (Currently amended.) The process of Claim 109, wherein step ~~(B)~~ (A) is conducted at an absolute pressure of about 1 bar.

111. (Cancelled.)

112. (Cancelled.)

113. (Cancelled.)

114. (Currently amended.) The process of Claim ~~167~~ 169, wherein the ~~fatty acid alkyl esters separated in the distillation or fractionation column meet~~ biodiesel recovered in step (D) meets ASTM specification D 6751.

115. (Cancelled.)

116. (Cancelled.)

117. (Cancelled.)

118. (Cancelled.)

119. (Currently amended.) The process of Claim ~~166~~ 159, wherein the

distillation or fractionation in step (C) is conducted in a column is operated at a temperature in the range of about 180°C to about 230°C.

120. (Cancelled.)

121. (Cancelled.)

122. (Previously presented.) The process of Claim 81, wherein the glycerin is purified by adjusting the pH of a glycerin rich stream to neutral.

123. (Currently amended.) The process of Claim 169, wherein the pH adjustment is performed using ion exchange media.

124. (Previously presented.) The process of Claim 100, wherein the C₁-C₅ alcohol is methanol.

125. (Cancelled.)

126. (Cancelled.)

127. (Cancelled.)

128. (Cancelled.)

129. (Currently amended.) The process of Claim ~~167~~ 168, wherein the at least one alcohol is a C₁-C₅ alcohol.

130. (Previously presented.) The process of Claim 129, wherein the C₁-C₅ alcohol is methanol.

131. (Currently amended.) The process of Claim ~~90~~ 159, wherein the process is continuous.

132. (Cancelled.)

133. (Cancelled.)

134. (Cancelled.)

135. (Cancelled.)

136. (Cancelled.)

137. (Currently amended.) The process of Claim ~~132~~ 159, wherein the distillation or fractionation is conducted in a column containing a packing material.

138. (Cancelled.)

139. (Currently amended.) The process of Claim ~~138~~ 169, wherein subsequent to step (C), the neutralized stream resulting from step (C) is purified.

140. (Previously presented.) The process of Claim 139, wherein the neutralized stream is purified by distillation or fractionation.
141. (Currently amended.) The process of Claim ~~138~~ 169, wherein the glycerides of step (A) are obtained by reacting a feedstock containing free fatty acids with glycerin.
142. (Previously presented.) The process of Claim 141, wherein the free fatty acids in the feedstock are reacted with glycerin in the absence of a catalyst.
143. (Currently amended.) The process of Claim ~~138~~ 169, wherein the glycerides are reacted with the at least one alcohol in the presence of an alkali catalyst.
144. (Currently amended.) The process of Claim ~~138~~ 169, wherein the at least one alcohol is a C₁-C₅ alcohol.
145. (Previously presented.) The process of Claim 144, wherein the C₁-C₅ alcohol is methanol.
146. (Currently amended.) The process of Claim ~~138~~ 169, wherein the pH is adjusted in step (C) by the addition of a mineral acid.
147. (Previously presented.) The process of Claim 146, wherein step (A) is conducted in the presence of an alkali catalyst and further wherein the mineral acid reacts with the alkali catalyst to render a precipitate and a precipitate-free permeate.
148. (Previously presented.) The process of Claim 147, wherein the precipitate is separated from the precipitate-free permeate by filtration.
149. (Previously presented.) The process of Claim 148, wherein prior to being separated from the precipitate-free permeate the precipitate is washed with methanol.
150. (Previously presented.) The process of Claim 147, wherein the precipitate-free permeate is further separated into a second fatty acid alkyl ester rich stream and a second glycerin rich stream.
151. (Previously presented.) The process of Claim 150, wherein the pH of the second glycerin rich stream is neutralized by the addition of caustic.
152. (Previously presented.) The process of Claim 146, wherein the mineral acid converts soaps formed in step (B) to free fatty acids.
153. (Previously presented.) The process of Claim 150, wherein the second fatty

alkyl ester rich stream is combined with the separated fatty acid alkyl ester stream of step (B) to form a combined stream.

154. (Previously presented.) The process of Claim 153, wherein the combined stream is fractionated.

155. (Previously presented.) The process of Claim 151, wherein the alcohol and water in the neutralized second glycerin rich stream are separated from the glycerin.

156. (Previously presented.) The process of Claim 155, wherein the separated glycerin is further subjected to distillation or fractionation to remove high boiling impurities.

157. (Previously presented.) The process of Claim 156, wherein the resulting glycerin stream is decolorized.

158. (Currently amended.) The process of Claim ~~135~~ 163, wherein the distillation or fractionation is ~~conducted in~~ column of step (C) contains ~~containing~~ a packing material.

159. (Currently amended.) A process for the production of biodiesel from glycerides comprising:

(A) reacting the glycerides with at least one alcohol ~~in at least two continuous stirred tank reactors~~ to produce a liquid stream containing fatty acid esters and glycerin;

(B) separating from the liquid stream of step (A) ~~a first liquid phase containing fatty acid alkyl esters and a second liquid phase containing glycerin~~ to produce a fatty acid alkyl ester rich stream and a glycerin rich stream; and

(C) ~~recovering a biodiesel containing~~ purifying the separated fatty acid alkyl esters ester rich stream by distillation or fractionation to produce biodiesel having an acid number less than or equal to 0.80 mg KOH/g and total glycerin less than or equal to 0.240% mass.

160. (Cancelled.)

161. (Cancelled.)

162. (Cancelled.)

163. (Previously presented.) A process for the production of biodiesel from glycerides comprising:

(A) reacting the glycerides with at least one alcohol to produce fatty acid esters and glycerin;

(B) separating a first liquid phase containing fatty acid alkyl esters and a second liquid phase containing glycerin to produce a fatty acid alkyl ester rich stream and a glycerin rich stream;

(C) separating the fatty acid alkyl ester rich stream in a distillation or fractionation column into a bottoms fraction, an overhead fraction comprising ~~essentially~~ alcohol and a side stream fraction comprising at least one fatty acid alkyl ester product; and

(D) recovering a biodiesel containing the separated fatty acid alkyl esters.

164. (Cancelled.)

165. (Cancelled.)

166. (Cancelled.)

167. (Cancelled.)

168. (Previously presented.) A process for the production of biodiesel from glycerides comprising:

(A) reacting the glycerides with at least one alcohol to produce fatty acid esters and glycerin;

(B) separating a first liquid phase containing fatty acid alkyl esters and a second liquid phase containing glycerin to produce a fatty acid alkyl ester rich stream and a glycerin rich stream;

(C) purifying the glycerin rich stream by subjecting it to distillation; and

(D) recovering a biodiesel containing the separated fatty acid alkyl esters.

169. (Previously presented.) A process for the production of biodiesel from glycerides comprising:

(A) reacting the glycerides with at least one alcohol to produce fatty acid esters and glycerin;

(B) separating a first liquid phase containing fatty acid alkyl esters and a second liquid phase containing glycerin to produce a fatty acid alkyl ester rich stream and a glycerin rich stream;

(C) adjusting the pH of the glycerin rich stream by adding an acid solution thereto; and

(D) recovering a biodiesel containing the separated fatty acid alkyl esters.

170. (Currently amended.) A process for the production of biodiesel from glycerides comprising:

(A) conditioning a feedstock containing free fatty acids ~~and then~~ to render a heterogeneous feedstock mixture of uniform viscosity;

(B) reacting the conditioned feedstock with glycerin to render glycerides;

~~(B)~~ (C) reacting the glycerides with at least one alcohol to produce fatty acid esters and glycerin;

~~(C)~~ (D) separating a first liquid phase containing fatty acid alkyl esters and a second liquid phase containing glycerin to produce a fatty acid alkyl ester rich stream and a glycerin rich stream; and

~~(D)~~ (E) recovering a biodiesel containing the separated fatty acid alkyl esters.

171. (Cancelled.)

172. (Currently amended.) The process of Claim ~~171~~ 96, wherein the distillation or fractionation column is operated at a temperature in the range of about 180°C to about 230°C.

173. (Cancelled.)

174. (Previously presented.) The process of Claim 159, further comprising adjusting the pH of the glycerin rich stream to neutral and then purifying the neutralized stream by distillation or fractionation.

175. (Cancelled.)

176. (Currently amended.) The process of Claim ~~160~~ 170, further comprising purifying the fatty acid alkyl ester rich stream in a distillation or fractionation column.

177. (Currently amended.) The process of Claim ~~160~~ 170, further comprising adjusting the pH of the glycerin rich stream to neutral and then purifying the neutralized stream by distillation or fractionation.

178. (Previously presented.) The process of Claim 176, wherein the distillation or fractionation column is operated at a temperature in the range of about 180°C to about 230°C.

179. (Cancelled.)

180. (Currently amended.) The process of Claim ~~161~~ 169, further comprising adjusting the pH of the glycerin rich stream to neutral and then purifying the neutralized stream

by distillation or fractionation.

181. (Cancelled.)

182. (Cancelled.)

183. (Cancelled.)

184. (Cancelled.)

185. (Cancelled.)

186. (Cancelled.)

187. (Cancelled.)

188. (Cancelled.)

189. (Cancelled.)

190. (Previously presented.) The process of Claim 169, further comprising purifying the fatty acid alkyl ester rich stream in a distillation or fractionation system.

191. (Cancelled.)

192. (Previously presented.) The process of Claim 170, wherein the free fatty acids in the feedstock are reacted with glycerin in the absence of a catalyst.

193. (Previously presented.) The process of Claim 170, wherein the free fatty acids in the feedstock are reacted with glycerin in a glycerolysis reactor, wherein the amount of glycerin introduced into the reactor is a stoichiometric excess which is required to produce glycerides.

194. (Cancelled.)

195. (Cancelled.)

196. (Currently amended.) The process of Claim ~~194~~ 176, wherein the distillation or fractionation column is operated at a temperature in the range of about 180°C to about 230°C.

197. (New.) The method of Claim 159, wherein the glycerides of step (A) are produced by reacting a feedstock containing free fatty acids with glycerin.

198. (New.) The method of Claim 78, wherein the feedstock and glycerin are reacted in at least two continuous stirred tank reactors.

199. (New.) The method of Claim 169, wherein the pH of the glycerin rich stream in step (C) is adjusted to neutral.

200. (New.) The method of Claim 163, wherein the bottoms fraction comprises impurities, unsaponifiable materials, unreacted monoglycerides, unreacted diglycerides, unreacted triglycerides and fatty acids.

201. (New.) A process for the production of biodiesel from glycerides comprising:

(A) reacting the glycerides with at least one alcohol to produce a liquid stream containing fatty acid alkyl ester and glycerin; and

(B) separating from the liquid stream of step (A) a fatty acid alkyl ester rich stream and a glycerin rich stream;

(C) removing alcohol from the fatty acid alkyl ester rich stream; and

(D) purifying the fatty acid alkyl ester rich stream by distillation or fractionation to produce purified biodiesel.

202. (New.) The process of Claim 197, wherein the reaction of the fatty acids in the feedstock and glycerin is conducted in at least two continuous stirred tank reactors.

203. (New.) The process of Claim 159, wherein a wet alcohol stream is recovered from the liquid stream.

204. (New.) The process of Claim 203, wherein the wet alcohol stream is purified in a distillation or fractionation column to remove excess water therefrom.

205. (New.) The process of Claim 159, wherein step (B) is conducted at a temperature in the range from about 150°C to about 250°C.

206. (New.) The process of Claim 159, wherein biodiesel produced in step (C) meets ASTM specification D 6751.

207. (New.) The process of Claim 163, further comprising adjusting the pH of the glycerin rich stream to neutral and then purifying the neutralized stream by distillation or fractionation.

208. (New.) The process of Claim 163, wherein the at least one alcohol is a C₁-C₅ alcohol.

209. (New.) The process of Claim 208, wherein the C₁-C₅ alcohol is methanol.

210. (New.) The process of Claim 163, wherein the biodiesel recovered in step (D) meets ASTM specification D 6751.

211. (New.) The process of Claim 163, wherein the overhead fraction comprises essentially alcohol.
212. (New.) The process of Claim 163, wherein the distillation or fractionation column is operated at a pressure below about 2 pounds per square inch absolute.
213. (New.) The process of Claim 163, wherein the distillation or fractionation column is operated at a pressure in the range of about 0.1 pounds per square inch absolute to about 2 pounds per square inch absolute.
214. (New.) The process of Claim 163, wherein the distillation or fractionation column is operated at a temperature in the range of about 180°C to about 280°C.
215. (New.) The process of Claim 214, wherein the distillation or fractionation column is operated at a temperature in the range of about 180°C to about 230°C.
216. (New.) The process of Claim 163, wherein the process is continuous.
217. (New.) The process of Claim 168, wherein prior to subjecting the glycerin rich stream to distillation, the pH of the glycerin rich stream is adjusted to neutral.
218. (New.) The process of Claim 168, wherein the biodiesel recovered in step (D) meets ASTM specification D 6751.
219. (New.) The process of Claim 170, wherein the at least one alcohol is a C₁-C₅ alcohol.
220. (New.) The process of Claim 219, wherein the C₁-C₅ alcohol is methanol.
221. (New.) The process of Claim 170, wherein the biodiesel recovered in step (D) meets ASTM specification D 6751.
222. (New.) The process of Claim 201, wherein the at least one alcohol is a C₁-C₅ alcohol.
223. (New.) The process of Claim 222, wherein the C₁-C₅ alcohol is methanol.
224. (New.) The process of Claim 201, wherein the purified biodiesel of step (D) meets ASTM specification D 6751.
225. (New.) The process of Claim 77, wherein the purified biodiesel produced in step (D) meets ASTM specification D 6751.
226. (New.) The process of Claim 163, wherein the biodiesel is removed from the side stream fraction of step (C).